DAT321/DIT847: Software Quality

Welcome to the examination for the *Software Quality* course. The examination is intended to last for max **4 hours** and is intended to be **anonymous** (i.e., the teacher grading your exam will not know your name). Therefore, it is important that you follow the instructions (in the separate exam cover sheet) and **DO NOT leave any information that would reveal your name on these pages.**

Each question has a number of points assigned shown in the square brackets. When the question is broken down into smaller sub-questions the part of the points for that specific sub-questions are also shown as following:

1. [10 pts].
    a. [2 pts]
    b. [8 pts]

The percentage of points and the corresponding grade is presented below (100 points in total):

% of points	DAT321	DIT847
[0, 50%)	U	U
[50%, 65%)	3	G
[65%, 85%)	4	G
[85%, 100%]	5	VG

Before handing in your exam, number and sort the sheets in task order. Write your **anonymous code** and page number on every page!

It is important that you write **clearly** so that the examiner can read you. If your handwriting is unreadable, then you will not get any points for that question. We will NOT assess grammar or spelling as long as your answer is readable, understandable and unambiguous.

The questions in this exam refer to the **ISO 25010:2011** that categorises internal and external software quality attributes into eight characteristics.

Simple calculators are also allowed, but NOT calculators in mobile phones.

Questions about the exam contact:
Francisco Gomes, tel. 031 772 69 51, gomesf@chalmers.se

The exam review is scheduled for 2020-01-24, between 13:00 – 14:30 at Jupiter building, 4th floor, Room 473.

The questions in this exam are related to the following context. Note that the answers should, in turn, be justified based on i) the theory and terminology from software quality and ii) their connections to the elements in this context (e.g., team, product, processes, architecture, etc.).

Context: You are hired by GPS-Co, a company responsible for developing a cloud-based system that offer various GPS services. You will be the quality assurance manager for teams B and C (see description of the teams below).

Software product:

The product is composed of several services, all of them related to GPS positioning and navigation. The product uses a microservices architecture, where the different services are loosely coupled and independently deployable. The services are accessed and integrated via APIs endpoints (i.e., entry points that work as method calls). The company requires all teams to use Continuous Integration practices and tools.

Customers, business, teams and software development process:

Currently GPS-Co has contracts with other companies that use the services provided by your software product. Currently, your main customer is the FoodDelivery-Co, which delivers food orders from supermarkets to customers. FoodDelivery-Co uses the GPS services on their fleet of trucks that deliver all food orders from supermarkets to customers who ordered online. Truck drivers use a Graphical User Interface (GUI) in the truck's dashboard panel. The GUI sends requests to the GPS-Co API, such as suggestion of routes that include all delivery points.

Today, GPS-Co signed a contract with another customer, Automotive-Co which is an automotive company that wants to use the GPS services for tracking and navigation of its manufactured cars. Therefore, as part of the contract, Automotive-Co will request several new features from your software product.

Team A is responsible for developing and maintaining the main features of your software product: i) the main application with the various GPS features, ii) the cloud infrastructure and platform where the service is hosted, iii) all non-functional aspects of the product. Team A has 50 members and is internally divided into small groups based on the specific services provided by the software product. Team A is composed of experience engineers with various testing and development skills.

Team B handles the development of customised features for FoodDelivery-Co, and is a small team with 8 people, all of them with wide experience in software development and agile software development. Team B reuses the features created by Team A in order to customize the product for FoodDelivery-Co. Since FoodDelivery-Co users rely on a GUI, Team A has one senior user experience (UX) designer.

GPS-Co is also hiring developers and testers for Team C that will work similarly to Team B but for Automotive-Co. Therefore, you must help with recruitment for this team.

1. **[30 pts]** Using the context above, answer the following questions:
    a. [15 pts] Choose three software product quality's characteristics, **and** provide examples of why they are relevant to the software product at GPS-Co.

    b. [5 pts] Explain the differences between product quality and quality in use.

    c. [10 pts] Provide two examples of how to measure quality in use of your product. Your example must include activity, entity under investigation and viewpoint.

2. **[10 pts]** Using your knowledge on software quality measures, answer the following:
    a. [5 pts] McCabe and Halstead are two distinct complexity measures used in software quality. Are they used for internal or external quality? Justify your answer.

    b. [5 pts] What are the differences between both measures in terms of software complexity?

3. **[25 pts]** Using your knowledge on Verification and Validation (V&V) and exploratory testing, answer the following questions:
    a. [5 pts] Explain the differences between fault, failure and error.

    b. [5 pts] Describe the advantages and disadvantages of using exploratory testing.

    c. [5 pts] Considering the different levels of testing in the V-model, should exploratory testing be used in all levels of testing? Justify your answer.

    d. [10 pts] A senior manager at GPS-Co asks whether the teams should use exploratory testing to improve test effectiveness at the company. Do you recommend exploratory testing to be used at GPS-Co? You must justify your answer based on the GPS-Co context provided such as teams, product, development process.

4. **[15 pts]** GPS-Co wants to contribute with sustainability in ICT. You must *suggest* or *explain* two sustainable features of your software product. Your explanation must include: (i) a description of the feature, (ii) why is it connected to sustainability in ICT, and (iii) which sustainability dimension is it connected to.

    Note: Here, you can interpret features as: new functionalities/services of your product, updates to the development process, or changes in the current software system.

5. **[20 pts]** Determined to improve the test effectiveness, a senior manager at GPS-Co wants to compare two different test techniques (*Technique A* and *Technique B*) regarding their fault detection capability. Therefore, she asks you to setup an experiment where 50 participants will use each technique and record the number of faults revealed. She also divided participants in two groups: junior and senior engineers to verify if their experience affects the number of faults revealed. An example of the data collected during the experiment is shown below:

Faults	Technique	Participant ID	Experience
8	Technique A	P1	Senior
7	Technique B	P1	Senior
4	Technique A	P2	Junior
8	Technique B	P2	Junior
10	Technique A	P3	Junior
12	Technique B	P3	Junior
…			

Write down the *mathematical model definition* for this experiment using *any* variable names and priors of your choice. State the ontological and epistemological reasons for your likelihood. Remember to clearly state and justify the choices and assumptions regarding your model.